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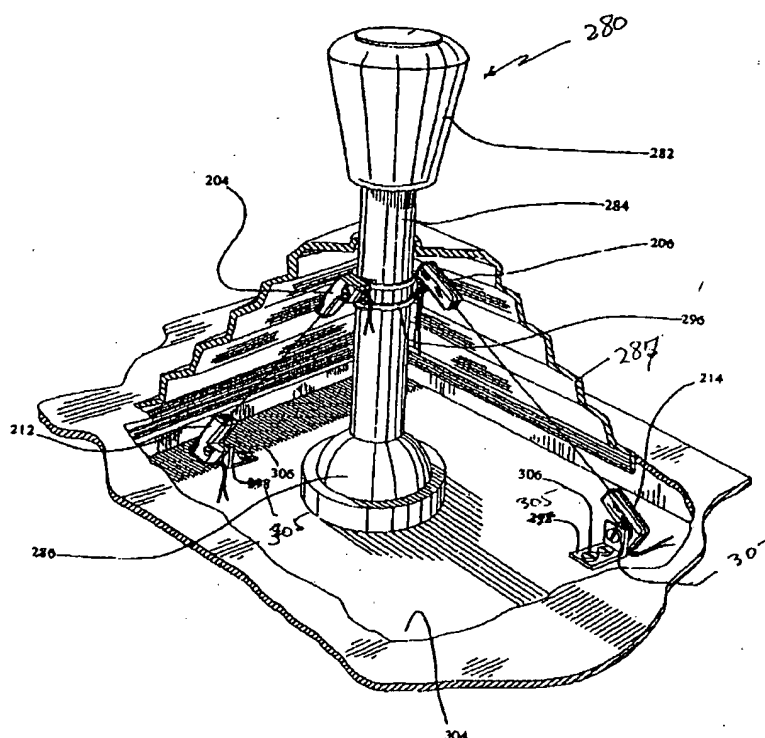
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(54) **DISPOSITIF DE VERRROUILLAGE OPTO-ELECTRIQUE
POUR DEMARREUR D'AUTOMOBILE**

(54) **AUTOMOTIVE OPTO-ELECTRIC STARTER INTERLOCK**

(57) Cette invention concerne un dispositif électro-optique de neutralisation du démarreur d'un véhicule automobile ayant pour fonction d'empêcher le démarrage à distance du moteur lorsque le sélecteur de vitesses n'est pas au neutre. Ce dispositif fait appel à un ensemble de détecteurs optiques montés sur le sélecteur de vitesses. Il détermine si le sélecteur est au neutre d'après le signal de sortie des détecteurs qui varie selon la position occupée par ledit sélecteur. Un microprocesseur excite des photoémetteurs et contrôle la réponse des détecteurs pour déterminer la position du sélecteur. Les signaux de sortie des détecteurs servent également à détecter les anomalies de fonctionnement du dispositif.

(57) An automotive opto-electric starter interlock for use in a motor vehicle for the purpose of preventing the engine from being remotely started unless the transmission is in neutral. The starter interlock includes an optical sensors array mounted to the transmission shift linkage. The output of the sensors is dependent upon the position of the shift linkage, hence allowing to determine if the transmission is in neutral. A microprocessor excites the sensors and observes their response to determine the position of the shift linkage. The information supplied by the sensors is also used to detect system malfunctions.

WE CLAIM:

1. An opto-electric interlock to prevent remote starting of a motor vehicle when a transmission of the vehicle establishes a driving relationship between an engine of the vehicle and a wheel thereof, said opto-electric interlock comprising:
 - a light source for supplying radiant energy; ✓
 - a light detector responsive to radiant energy incoming from said light source, said light source and said light detector assuming a state of optical coupling in response to movement of a shift linkage of the transmission of the vehicle to a spacial position in which the driving relationship between the engine of the vehicle and the wheel thereof is terminated, whereby an output condition of said light detector enables to determine whether the transmission of the vehicle is in gear; ✓
 - a processing unit controlling actuation of said light source, said processing unit being responsive to the output condition of said light detector in order to assume either one of a start enable state and a starter disable state, in said start enable state said processing unit enabling remote actuation of a starter motor of the vehicle, in said starter disable state said processing unit precluding remote actuation of the starter motor, whereby said processing unit is capable of switching between said start enable state and said starter disable

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state in dependence of a spacial position of the shift linkage, said processing unit including diagnosis means for sensing detectable malfunctions in said opto-electric interlock, said diagnosis means including:

5 a) an excitation unit for actuating said light source in a predetermined manner; ✓

 b) means for observing the output condition of said light detector; ✓

 c) a comparing unit for comparing the output
10 condition of said light detector observed at step b) with a response characteristic of the opto-electric interlock in an unimpaired operative condition, upon absence of agreement between the output condition at step b) and said response, said processing unit assuming said starter
15 disable state in order to preclude remote actuation of the starter motor of the vehicle. ✓

2. An opto-electric interlock as defined in claim 1, wherein said excitation unit causes said light source
20 to assume a sequence of operative states at predetermined instants in time.

3. An opto-electric interlock as defined in claim 2, wherein one of said operative states is actuation of
25 said light source to cause said light source to emit radiant energy during a first time interval.

4. An opto-electric interlock as defined in claim 3, wherein the other of said operative states is de-actuation of said light source, whereby said light source generates no radiant energy during a second time interval.

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5. An opto-electric interlock as defined in claim 4, wherein said processing unit is capable of assuming said starter disable state unless said light detector manifests:

- 10 a) an output condition during said first time interval indicative of presence of radiant energy; and
b) an output condition during said second time interval indicative of absence of radiant energy.

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6. An opto-electric interlock as defined in claim 1, comprising:

- first and second light sources for supplying radiant energy;

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- first and second light detectors responsive to radiant energy incoming from said first and second light sources, respectively, said excitation unit actuating said first and second light sources in a predetermined manner.

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7. An opto-electric interlock as defined in claim 6, wherein said excitation unit causes actuation of said first and second light sources at different instants in time.

8. An opto-electric interlock as defined in claim 7, wherein said processing unit is capable of assuming said starter disable state when either one of conditions a and b are met:

5 a) said first light detector manifests:

an output condition indicative of presence of radiant energy when said first light source is de-actuated and said second light source is actuated; and

b) said second light detector manifests:

10 an output condition indicative of presence of radiant energy when said second light source is de-actuated and said first light source is actuated.

9. An opto-electric interlock as defined in claim 15 7, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detector manifests an output condition indicative of presence of radiant energy when said first and second light sources are de-actuated.

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10. An opto-electric interlock as defined in claim 7, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detector manifests an output condition 25 indicative of absence of radiant energy when said first and second light sources are actuated.

11. An opto-electric interlock to prevent remote starting of a motor vehicle when a transmission of the vehicle establishes a driving relationship between an engine of the vehicle and a wheel thereof, said opto-electric interlock comprising:

- a light source for supplying radiant energy;
- a light detector responsive to radiant energy incoming from said light source, said light source and said light detector assuming a state of optical coupling in response to movement of a shift linkage of the transmission of the vehicle to a spacial position in which the driving relationship between the engine of the vehicle and the wheel thereof is terminated, whereby an output condition of said light detector enables to determine whether the transmission of the vehicle is in gear;
- a processing unit controlling actuation of said light source, said processing unit including an excitation unit for causing said light source to assume a sequence of operative states at predetermined instants in time, a first of said operative states corresponding to actuation of said light source to cause said light source to emit radiant energy during a first time interval, a second of said operative states corresponding to de-actuation of said light source, whereby said light source generates no radiant energy during a second time interval, said processing unit being responsive to the output condition of said light detector in order to assume either

one of a start enable state and a starter disable state,
in said start enable state said processing unit enabling
remote actuation of a starter motor of the vehicle, in
said starter disable state said processing unit precluding
5 remote actuation of the starter motor, whereby said
processing unit is capable of switching between said start
enable state and said starter disable state in dependence
of a spacial position of the shift linkage, said
processing unit assuming said start enable state when said
10 light detector manifests:

a) an output condition during said first time
interval indicative of presence of radiant energy; and

b) an output condition during said second time
interval indicative of absence of radiant energy.

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12. An opto-electric interlock as defined in claim
11, comprising:

- first and second light sources for supplying
radiant energy;

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- first and second light detectors responsive to
radiant energy incoming from said first and second light
sources, respectively, said excitation unit actuating said
first and second light sources in a predetermined manner.

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13. An opto-electric interlock as defined in claim
12, wherein said excitation unit causes actuation of said

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first and second light sources at different instants in time.

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14. An opto-electric interlock as defined in claim 13, wherein said processing unit assumes said starter disable state in occurrence of either one of conditions a and b:

a) said first light detector manifests:

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an output condition indicative of presence of radiant energy when said first light source is de-actuated and said second light source is actuated; and

b) said second light detector manifests:

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an output condition indicative of presence of radiant energy when said second light source is de-actuated and said first light source is actuated.

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15. An opto-electric interlock as defined in claim 12, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detectors manifests an output condition indicative of presence of radiant energy when said first and second light sources are de-actuated.

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16. An opto-electric interlock as defined in claim 12, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detectors manifests an output condition

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indicative of absence of radiant energy when said first and second light sources are actuated.

5 17. An opto-electric interlock as defined in claim 11, wherein said excitation unit causes said light source to assume said sequence of said operative states in repetition.

10 18. An opto-electric interlock as defined in claim 16, wherein said processing unit assumes said start enable state when said detector successively responds with the output conditions a) and b) of claim 1 to a plurality of sequences of said operative states.

15 19. An opto-electric interlock as defined in claim 18, wherein said processing unit includes an input for receiving a signal indicative of an operative state of a starter motor of said vehicle, in response to said signal
20 said processing unit assuming either one of a first and second test modes for assessing whether the transmission of the vehicle is in gear, said processing unit acquiring said first test mode when said signal indicates that the starter motor of the vehicle is operating to crank the engine
25 thereof and said second test mode when said signal indicates that the starter motor of the vehicle is inactive,

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5 i) under said first test mode said processing unit switching to said starter disable state when said detector fails to respond with the output conditions a) and b) of claim 11 to X successive sequences of said operative states,

10 ii) under said second test mode said processing unit switching to said starter disable state when said detector fails to respond with the output conditions a) and b) of claim 11 to Y successive sequences of said operative states.

15 20. An opto-electric interlock as defined in claim 11, wherein said processing unit comprises an input for receiving a signal indicative on an operational state of a parking brake of the vehicle, said processing unit assuming said starter disable state in response to said signal when said signal indicates that the parking brake is released.

20 21. An opto-electric interlock as defined in claim 11, wherein said radiant energy is light in the infrared range of the spectrum.

25 22. An opto-electric interlock as defined in claim 11, wherein said processing unit comprises an input for receiving an input signal representative of a state of conduction of an electric circuit of the vehicle, the

electric circuit acquiring a closed state preparatory to energization of the starter motor of the vehicle, said processing unit further comprising an output for generating an output signal for controlling a state of conduction of an electric circuit effecting energization of the starter motor of the vehicle, in response to said input signal indicating that the electric circuit of the vehicle assumes the closed state, said processing unit when in said starter disable state outputting said output signal to prevent energization of the starter motor of the vehicle.

23. An opto-electric interlock as defined in claim 22, wherein said output signal drives a power switch in series with the electric circuit effecting energization of the starter motor of the vehicle.

24. An interlock to prevent remote starting of a motor vehicle when a transmission of the vehicle establishes a driving relationship between an engine of the vehicle and a wheel thereof, said interlock comprising:

- first sensor means responsive to movement of a shift linkage of the transmission, whereby an output condition of said sensor means allows to determine if the transmission of the vehicle is in gear;

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5 - second sensor means responsive to an operative condition of a parking brake of the vehicle, whereby an output condition of said second sensor means enables to determine whether the parking brake is released or applied;

10 - a processing unit coupled to said first and second sensor means, said processing unit being capable of assuming either one of a start enable state and a starter disable state in dependence upon the output conditions of said first and second sensor means, in said start enable state said processing unit enabling remote actuation of a starter motor of the vehicle, in said starter disable state said processing unit precluding remote actuation of the starter motor, said processing unit including memory
15 means for storing data representative of the output condition of said first sensor means when the output condition of said second sensor means indicates that the parking brake is released, said processing unit assuming said start enable state in response to:

20 a) a current output condition of said second sensor means indicates that the parking brake is applied;

25 b) a current output condition of said first sensor means indicates that the driving relationship between the engine of the vehicle and the wheel thereof is terminated; and

c) a contents of said memory means indicates occurrence of a driving relationship between the engine of the vehicle and the wheel thereof.

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25. An interlock as defined in claim 24, wherein said first sensor means comprises:

- a light source for supplying radiant energy;
- a light detector responsive to radiant energy

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incoming from said light source, said light source and said light detector assuming a state of optical coupling in response to movement of a shift linkage of the transmission of the vehicle to a spacial position in which the driving relationship between the engine of the vehicle and the wheel thereof is terminated.

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26. An interlock as defined in claim 25, wherein said processing unit including an excitation unit for causing said light source to assume a sequence of operative states at predetermined instants in time, a first of said operative states corresponding to actuation of said light source to cause said light source to emit radiant energy during a first time interval, a second of said operative states corresponding to de-actuation of said light source, whereby said light source generates no radiant energy during a second time interval, said processing unit assuming said start enable state when said light detector manifests:

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a) an output condition during said first time interval indicative of presence of radiant energy; and

b) an output condition during said second time interval indicative of absence of radiant energy.

27. An interlock as defined in claim 25, wherein said radiant energy is light in the infrared range of the spectrum.

28. A group of opto-electric components for detecting a position of a gear shift linkage in a motor vehicle, said group of opto-electric components comprising:

- a light source element for generating radiant energy;

- a light detector element responsive to the radiant energy emitted by said light source element, said light source element and said light detector element being mounted in respective housings, a first one of said housings being capable of engaging the gear shift linkage, whereby movement of the gear shift linkage causes movement of said first housing and the element mounted therein, a second one of said housings being adapted for mounting to a location adjacent the gear shift lever, whereby move of the gear shift linkage causes a relative movement between said light source element and said light detector element, said light source element and said detector elements

being capable of assuming a state of optical coupling when the gear shift linkage is in a predetermined position in which said light source element generates light within a filed of view of said light detector element, in said state of optical coupling said light detector element manifesting an output condition indicative of presence of radiant energy which signals that the gear shift linkage is in the predetermined position.

29. A group of opto-electric components as defined in claim 28, wherein each said housing comprises:

- a body of material substantially opaque to said radiant energy;

- an elongated light passage formed in said body for receiving therein one of said elements in a recessed condition relative an opening of said light passage.

30. A group of opto-electric components as defined in claim 29, wherein said light passage is provided with internal grooves extending generally transversely to a light propagation path through said passage, said grooves constituting means for scattering light reflected on an internal wall of said light passage.

31. A group of opto-electric components as defined in claim 29, wherein said first housing comprises a gear shift lever mounting member, said member including a

recessed surface conforming to an outer face of the gear shift lever.

5 32. A group of opto-electric components as defined in claim 31, wherein said recessed surface is concave.

10 33. A group of opto-electric components as defined in claim 31, wherein said first housing comprises an aperture for receiving a fastener releasably joining said first housing and said gear shift lever mounting member.

15 34. A group of opto-electric components as defined in claim 31, wherein said gear shift lever mounting member includes a groove for receiving a tie wrap for encircling the gear shift lever and maintaining said mounting member against the gear shift lever.

20 35. A group of opto-electric components as defined in claim 31, wherein said recessed surface is coated with adhesive to bond said mounting member to the gear shift lever.

25 36. A group of opto-electric components as defined in claim 28, comprising:

- a first pair of optical elements including a light source element and a light detector element; and

5 - a second pair of optical elements including a light source element and a light detector element, one element of each said first and second pairs of optical elements being adapted for mounting to the gear shift lever of the vehicle.

10 37. A group of opto-electric components as defined in claim 28, wherein said light source element is a light emitting diode capable of generating light in the infrared range of the spectrum.

15 38. A group of opto-electric components as defined in claim 37, wherein said light detector element is a phototransistor responsive to infrared radiation.